IN THE CLAIMS:

The following listing of claims will replace all prior versions, and listings, of claims in the application.

1.   (Original)   A computer-implemented method for determining from an input color filter array (CFA) sampled image, an edge direction, the method comprising:

calculating for a current missing green pixel, interpolation errors in an East-West (EW) direction at known neighboring green pixels, and averaging the EW interpolation errors to obtain an EW error;

calculating for the current missing green pixel, interpolation errors in a North-South (NS) direction at known neighboring green pixels, and averaging the NS interpolation errors to obtain a NS error; and

selecting a direction indicated by a minimum of the EW error and the NS error as the edge direction.

2.   (Currently amended)   The method of claim 1 wherein the selected edge direction[[,]] and the sampled image, which includes a green channel (G) of green pixels, a red channel (R) of red pixels, and a blue channel (B) of blue pixels, are used to interpolate missing green pixels at red and blue locations in the green channel by:

for the missing green pixel, interpolating a difference image comprising the G-B if the missing green pixel is in a blue location, or G-R if the missing green pixel is in a red location, in the selected edge direction;

in the blue channel, estimating missing blue pixels in green pixel locations using linear interpolation of the blue pixels in the blue channel in the selected edge direction; and

in the red channel, estimating the missing red pixels in ~~blue~~ green pixel locations using linear interpolation of the red pixels in the red channel in the selected direction, thereby providing an interpolated full green channel in which all missing green pixels have an interpolated value.

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3. (Original) The method of claim 2 wherein the sampled image and the full green channel are used to correct the green channel by:

calculating the EW and NS interpolation errors for each pixel in the full green channel;

averaging neighboring EW and NS errors at each green pixel;

selecting the green local edge direction EW or NS based on the EW and NS average errors having a smallest value;

estimating the green pixels at blue pixel locations using linear interpolation of G-B in the selected direction, and wherein the missing blue pixels are interpolated in the selected direction; and

estimating the green pixels at red pixel locations using linear interpolation of G-R in the selected direction, and wherein the missing red pixels are interpolated in the selected direction.

4. (Original) The method of claim 2 wherein the sampled image and the full green channel are used to interpolate the red and blue pixels to obtain a quincunx sampling by:

using the full green channel to estimate a local EW or NS edge direction by calculating errors in interpolation in EW and NS directions at each pixel;

labeling each pixel's direction as one of EW or NS based on a minimum of the EW and NS average errors in a neighborhood of the current green pixel;

at missing red quincunx samples, interpolating R-G in the direction of the label; and

at missing blue quincunx samples, interpolating B-G in the direction of the label.

5. (Original) The method of claim 2 wherein the quincunx sampled red and blue channels and the full green channel are used to interpolate the red and blue pixels to obtain full red and blue channels by:

using the full green channel to estimate a NE or NW edge direction by calculating errors in interpolation in NE and NW directions at each pixel;

labeling each pixel's direction as one of NE or NW based on a minimum of NE and NW average errors in a neighborhood of the current green pixel;

at the missing quincunx samples interpolating R-G in the direction of the local label; and

at the missing quincunx samples interpolating B-G in the direction of the local label.

6.   (Currently amended)   The method of claim 2 wherein corrected high density red, green, and blue channels are obtained from the input ~~the~~ full red, green, and blue channels by:

using the G-R channel to estimate a local EW, NE, NS, or NW edge direction by calculating errors in interpolation of the G-R channel in the EW, NE, NS, and NW directions at each pixel;

labeling each pixel's direction as one of EW, NE, NS, or NW based on a minimum of the average errors in a neighborhood of the corresponding pixel;

interpolating G-R in the direction of the label;

adding the red channel to the interpolated G-R to obtain a G_R channel;

using the G-B channel to estimate local EW, NE, NS, or NW edge direction by calculating errors in interpolation of the G-B channel in the EW, NE, NS, and NW directions at each pixel;

labeling each pixel's direction as one of EW, NE, NS, or NW based on a minimum of the average errors in a neighborhood of the corresponding pixel;

interpolating G-B in the direction of the label;

adding the blue channel to the interpolated G-B to obtain the G_B channel;

averaging the G_R and G_B channels in order to obtain a new green channel (G_{new});

calculating R-G_{new} channel;

using R-G_{new} to estimate a local EW, NE, NS, or NW edge direction by calculating errors in interpolation in the EW, NE, NS, and NW directions at each pixel;

labeling each pixel's direction as one of EW, NE, NS, or NW based on a minimum of the average errors in a neighborhood of the corresponding pixel;

interpolating R-G_{new} in the direction of the label;

adding the new green channel to the interpolated R-G$_{new}$ to obtain a new red channel;

calculating B-G$_{new}$;

using B-G$_{new}$ to estimate local EW, NE, NS, or NW edge direction by calculating the errors in interpolation in the EW, NE, NS, and NW directions at each pixel;

labeling each pixel's direction as one of EW, NE, NS, or NW based on a minimum of the average errors in a neighborhood of the corresponding pixel;

interpolating B-G$_{new}$ in the direction of the label; and

adding the new green channel to the interpolated B-G$_{new}$ to obtain a new blue channel.

7.   (Original) A computer-implemented method for obtaining corrected high-density red (R), green (G), and blue (B) channels from interpolated red, green, and blue channels from an input color filter array (CFA) sampled image, the method comprising:

calculating a G-R channel;

using the G-R channel to estimate a local EW, NE, NS, or NW edge direction by calculating errors in interpolation of the G-R channel in the EW, NE, NS, and NW directions at each pixel;

labeling each pixel's direction as one of EW, NE, NS, or NW based on a minimum of the average errors in a neighborhood of the corresponding pixel;

interpolating G-R in the direction of the label;

adding the red channel to the interpolated G-R to obtain a G$_R$ channel;

calculating the G-B channel;

using the G-B channel to estimate local EW, NE, NS, or NW edge direction by calculating errors in interpolation of the G-B channel in the EW, NE, NS, and NW directions at each pixel;

labeling each pixel's direction as one of EW, NE, NS, or NW based on a minimum of the average errors in a neighborhood of the corresponding pixel;

interpolating G-B in the direction of the label;

adding the blue channel to the interpolated G-B to obtain the G$_B$ channel;

averaging the G$_R$ and G$_B$ channels in order to obtain a new green channel (G$_{new}$);

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calculating R-G$_{new}$ channel;

using R-G$_{new}$ to estimate a local EW, NE, NS, or NW edge direction by calculating errors in interpolation in the EW, NE, NS, and NW directions at each pixel;

labeling each pixel's direction as one of EW, NE, NS, or NW based on a minimum of the average errors in a neighborhood of the corresponding pixel;

interpolating R-G$_{new}$ in the direction of the label;

adding the new green channel to the interpolated R-G$_{new}$ to obtain a new red channel;

calculating B-G$_{new}$;

using B-G$_{new}$ to estimate local EW, NE, NS, or NW edge direction by calculating the errors in interpolation in the EW, NE, NS, and NW directions at each pixel;

labeling each pixel's direction as one of EW, NE, NS, or NW based on a minimum of the average errors in a neighborhood of the corresponding pixel;

interpolating B-G$_{new}$ in the direction of the label; and

adding the new green channel to the interpolated B-G$_{new}$ to obtain a new blue channel.

8.   (Currently amended)   A computer-readable medium <u>comprising</u> ~~containing~~ program instructions for determining from an input color filter array (CFA) sampled image, an edge direction, <u>wherein</u> the program instructions <u>are computer-executable to implement a method</u> for:

calculating for a current missing green pixel, interpolation errors in an East-West (EW) direction at known neighboring green pixels, and averaging the EW interpolation errors to obtain an EW error;

calculating for the current missing green pixel, interpolation errors in a North-South (NS) direction at known neighboring green pixels, and averaging the NS interpolation errors to obtain a NS error; and

selecting a direction indicated by a minimum of the EW error and the NS error as the edge direction.

9.   (Currently amended) The computer-readable medium of claim 8 wherein the program instructions are further executable to implement a method for using the selected edge direction[[,]] and the sampled image, which includes a green channel (G) of green pixels, a red channel (R) of red pixels, and a blue channel (B) of blue pixels, are used to interpolate missing green pixels at red and blue locations in the green channel by:

for the missing green pixel, interpolating a difference image comprising the G-B if the missing green pixel is in a blue location, or G-R if the missing green pixel is in a red location, in the selected edge direction;

in the blue channel, estimating missing blue pixels in green pixel locations using linear interpolation of the blue pixels in the blue channel in the selected edge direction; and

in the red channel, estimating the missing red pixels in blue green pixel locations using linear interpolation of the red pixels in the red channel in the selected direction, thereby providing an interpolated full green channel in which all missing green pixels have an interpolated value.

10.   (Currently amended) The computer-readable medium of claim 9 wherein the program instructions are further executable to implement a method for using the sampled image and the full green channel are used to correct the green channel by:

calculating the EW and NS interpolation errors for each pixel in the full green channel;

averaging neighboring EW and NS errors at each green pixel;

selecting the green local edge direction EW or NS based on the EW and NS average errors having a smallest value;

estimating the green pixels at blue pixel locations using linear interpolation of G-B in the selected direction, and wherein the missing blue pixels are interpolated in the selected direction; and

estimating the green pixels at red pixel locations using linear interpolation of G-R in the selected direction, and wherein the missing red pixels are interpolated in the selected direction.

11.   (Currently amended) The computer-readable medium of claim 9 wherein the program instructions are further executable to implement a method for using the input sampled image and the full green channel are used to interpolate the red and blue pixels to obtain a quincunx sampling by:

using the full green channel to estimate a local EW or NS edge direction by calculating errors in interpolation in EW and NS directions at each pixel;

labeling each pixel's direction as one of EW or NS based on a minimum of the EW and NS average errors in a neighborhood of the current green pixel;

at missing red quincunx samples, interpolating R-G in the direction of the label; and

at missing blue quincunx samples, interpolating B-G in the direction of the label.

12.   (Currently amended) The computer-readable medium of claim 9 wherein the program instructions are further executable to implement a method for using the quincunx sampled red and blue channels and the full green channel are used to interpolate the red and blue pixels to obtain full red and blue channels by:

using the full green channel to estimate a NE or NW edge direction by calculating errors in interpolation in NE and NW directions at each pixel;

labeling each pixel's direction as one of NE or NW based on a minimum of NE and NW average errors in a neighborhood of the current green pixel;

at the missing quincunx samples interpolating R-G in the direction of the local label; and

at the missing quincunx samples interpolating B-G in the direction of the local label.

13.   (Currently amended) The computer-readable medium of claim 9 wherein the program instructions are further executable to implement a method for obtaining the corrected high density red, green, and blue channels are obtained from the input the full red, green, and blue channels by:

using the G-R channel to estimate a local EW, NE, NS, or NW edge direction by calculating errors in interpolation of the G-R channel in the EW, NE, NS, and NW directions at each pixel;

labeling each pixel's direction as one of EW, NE, NS, or NW based on a minimum of the average errors in a neighborhood of the corresponding pixel;

interpolating G-R in the direction of the label;

adding the red channel to the interpolated G-R to obtain a G_R channel;

using the G-B channel to estimate local EW, NE, NS, or NW edge direction by calculating errors in interpolation of the G-B channel in the EW, NE, NS, and NW directions at each pixel;

labeling each pixel's direction as one of EW, NE, NS, or NW based on a minimum of the average errors in a neighborhood of the corresponding pixel;

interpolating G-B in the direction of the label;

adding the blue channel to the interpolated G-B to obtain the G_B channel;

averaging the G_R and G_B channels in order to obtain a new green channel (G_{new});

calculating $R-G_{new}$ channel;

using $R-G_{new}$ to estimate a local EW, NE, NS, or NW edge direction by calculating errors in interpolation in the EW, NE, NS, and NW directions at each pixel;

labeling each pixel's direction as one of EW, NE, NS, or NW based on a minimum of the average errors in a neighborhood of the corresponding pixel;

interpolating $R-G_{new}$ in the direction of the label;

adding the new green channel to the interpolated $R-G_{new}$ to obtain a new red channel;

calculating $B-G_{new}$;

using $B-G_{new}$ to estimate local EW, NE, NS, or NW edge direction by calculating the errors in interpolation in the EW, NE, NS, and NW directions at each pixel;

labeling each pixel's direction as one of EW, NE, NS, or NW based on a minimum of the average errors in a neighborhood of the corresponding pixel;

interpolating $B-G_{new}$ in the direction of the label; and

adding the new green channel to the interpolated $B-G_{new}$ to obtain a new blue channel.

14.   (Original) An electronic device, comprising:

an input color filter array (CFA) for filtering light at a time of image capture;

a charge coupled device (CCD) for sensing the filitered light to produce a sampled image;

a processor for processing the sampled image; and

an edge directed demosaicing algorithm executed by the processor for:

calculating for a current missing green pixel, interpolation errors in an East-West (EW) direction at known neighboring green pixels, and averaging the EW interpolation errors to obtain an EW error;

calculating for the current missing green pixel, interpolation errors in a North-South (NS) direction at known neighboring green pixels, and averaging the NS interpolation errors to obtain a NS error; and

selecting a direction indicated by a minimum of the EW error and the NS error as the edge direction.

15.   (Currently amended) The electronic device of claim 14 wherein the selected edge direction, the sampled image, which includes a green channel (G) of green pixels, a red channel (R) of red pixels, and a blue channel (B) of blue pixels, are used to interpolate missing green pixels at red and blue locations in the green channel by:

for the missing green pixel, interpolating a difference image comprising the G-B if the missing green pixel is in a blue location, or G-R if the missing green pixel is in a red location, in the selected edge direction;

in the blue channel, estimating missing blue pixels in green pixel locations using linear interpolation of the blue pixels in the blue channel in the selected edge direction; and

in the red channel, estimating the missing red pixels in ~~blue~~ <u>green</u> pixel locations using linear interpolation of the red pixels in the red channel in the selected direction, thereby providing an interpolated full green channel in which all missing green pixels have an interpolated value.

16.   (Original) The electronic device of claim 15 wherein the sampled image and the full green channel are used to correct the green channel by:

calculating the EW and NS interpolation errors for each pixel in the full green channel;

averaging neighboring EW and NS errors at each green pixel;

selecting the green local edge direction EW or NS based on the EW and NS average errors having a smallest value;

estimating the green pixels at blue pixel locations using linear interpolation of G-B in the selected direction, and wherein the missing blue pixels are interpolated in the selected direction; and

estimating the green pixels at red pixel locations using linear interpolation of G-R in the selected direction, and wherein the missing red pixels are interpolated in the selected direction.

17.   (Original) The electronic device of claim 15 wherein the sampled image and the full green channel are used to interpolate the red and blue pixels to obtain a quincunx sampling by:

using the full green channel to estimate a local EW or NS edge direction by calculating errors in interpolation in EW and NS directions at each pixel;

labeling each pixel's direction as one of EW or NS based on a minimum of the EW and NS average errors in a neighborhood of the current green pixel;

at missing red quincunx samples, interpolating R-G in the direction of the label; and

at missing blue quincunx samples, interpolating B-G in the direction of the label.

18.   (Original) The electronic device of claim 15 wherein the quincunx sampled red and blue channels and the full green channel are used to interpolate the red and blue pixels to obtain full red and blue channels by:

using the full green channel to estimate a NE or NW edge direction by calculating errors in interpolation in NE and NW directions at each pixel;

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labeling each pixel's direction as one of NE or NW based on a minimum of NE and NW average errors in a neighborhood of the current green pixel;

at the missing quincunx samples interpolating R-G in the direction of the local label; and

at the missing quincunx samples interpolating B-G in the direction of the local label.

19.   (Currently amended) The electronic device of claim 15 wherein corrected high density red, green, and blue channels are obtained from the input ~~the~~ full red, green, and blue channels by:

using the G-R channel to estimate a local EW, NE, NS, or NW edge direction by calculating errors in interpolation of the G-R channel in the EW, NE, NS, and NW directions at each pixel;

labeling each pixel's direction as one of EW, NE, NS, or NW based on a minimum of the average errors in a neighborhood of the corresponding pixel;

interpolating G-R in the direction of the label;

adding the red channel to the interpolated G-R to obtain a G_R channel;

using the G-B channel to estimate local EW, NE, NS, or NW edge direction by calculating errors in interpolation of the G-B channel in the EW, NE, NS, and NW directions at each pixel;

labeling each pixel's direction as one of EW, NE, NS, or NW based on a minimum of the average errors in a neighborhood of the corresponding pixel;

interpolating G-B in the direction of the label;

adding the blue channel to the interpolated G-B to obtain the G_B channel;

averaging the G_R and G_B channels in order to obtain a new green channel (G_{new});

calculating R-G_{new} channel;

using R-G_{new} to estimate a local EW, NE, NS, or NW edge direction by calculating errors in interpolation in the EW, NE, NS, and NW directions at each pixel;

labeling each pixel's direction as one of EW, NE, NS, or NW based on a minimum of the average errors in a neighborhood of the corresponding pixel;

interpolating R-G_{new} in the direction of the label;

adding the new green channel to the interpolated R-G$_{new}$ to obtain a new red channel;

calculating B-G$_{new}$;

using B-G$_{new}$ to estimate local EW, NE, NS, or NW edge direction by calculating the errors in interpolation in the EW, NE, NS, and NW directions at each pixel;

labeling each pixel's direction as one of EW, NE, NS, or NW based on a minimum of the average errors in a neighborhood of the corresponding pixel;

interpolating B-G$_{new}$ in the direction of the label; and

adding the new green channel to the interpolated B-G$_{new}$ to obtain a new blue channel.

20.   (New) A computer-readable storage medium, comprising program instructions, wherein the program instructions are computer-executable to determine an edge direction for a known plurality of pixels in a sampled image, in which each known pixel in the known plurality of pixels represents one of a first type pixel, a second type pixel, or a third type pixel, and wherein the edge direction is operable to be used as an interpolation direction to determine, for a current known second type pixel or third type pixel of the known plurality of pixels, an associated interpolated first type pixel, the program instructions being executable to:

calculate, for the current known pixel of the known plurality of pixels, an interpolation error in an East-West (EW) direction of a known neighboring first type pixel;

calculate, for the current known pixel of the known plurality of pixels, an interpolation error in a North-South (NS) direction of a known neighboring first type pixel; and

select an EW direction for the edge direction if the interpolation error in the EW direction is less than the interpolation error in the NS direction or select a NS direction for the edge direction if the interpolation error in the NS direction is less than the interpolation error in the EW direction.

21. (New) The computer-readable storage medium of claim 20, wherein the first type pixel is a green pixel, the second type pixel is a blue pixel, and the third type pixel is a red pixel.

22. (New) The computer-readable storage medium of claim 20, wherein the interpolation error in the EW direction corresponds to a sum of (a known first type pixel west of the known neighboring first type pixel and a known first type pixel east of the known neighboring first type pixel) minus two times the known neighboring first type pixel.

23. (New) The computer-readable storage medium of claim 20, wherein the interpolation error in the NS direction corresponds to a sum of (a known first type pixel north of the known neighboring first type pixel and a known first type pixel south of the known neighboring first type pixel) minus two times the known neighboring first type pixel.

24. (New) The computer-readable storage medium of claim 20,

wherein calculating an interpolation error in the EW direction for the current known pixel comprises calculating interpolation errors in the EW direction for at least two known neighboring first type pixels and summing the calculated interpolation errors in the EW direction to derive a cumulative interpolation error in the EW direction;

wherein calculating an interpolation error in the NS direction for the current known pixel comprises calculating interpolation errors in the NS direction for at least two known neighboring first type pixels and summing the calculated interpolation errors in the NS direction to derive a cumulative interpolation error in the NS direction; and

wherein selecting the edge direction comprises selecting an EW direction for the edge direction if the cumulative interpolation error in the EW direction is less than the cumulative interpolation error in the NS direction or selecting a NS direction for the edge direction if the cumulative interpolation error in the NS direction is less than the cumulative interpolation error in the EW direction.

25.   (New) The computer-readable storage medium of claim 20,

wherein calculating an interpolation error in the EW direction for the known current pixel comprises calculating interpolation errors in the EW direction for at least two known neighboring first type pixels and averaging the calculated interpolation errors in the EW direction to derive an averaged interpolation error in the EW direction;

wherein calculating an interpolation error in the NS direction for the known current pixel comprises calculating interpolation errors in the NS direction for at least two known neighboring first type pixels and averaging the calculated interpolation errors in the NS direction to derive an averaged interpolation error in the NS direction; and

wherein selecting the edge direction comprises selecting an EW direction for the edge direction if the averaged interpolation error in the EW direction is less than the averaged interpolation error in the NS direction or selecting a NS direction for the edge direction if the averaged interpolation error in the NS direction is less than the averaged interpolation error in the EW direction.